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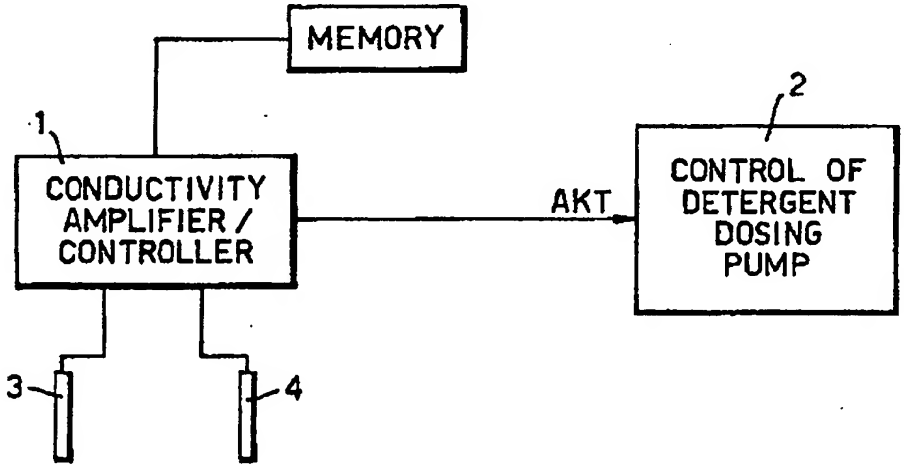
(54) Title: METHOD OF DOSING DETERGENT PRODUCT



(57) Abstract

A method is provided of dosing detergent product into a washing solution present in an industrial washing machine, comprising measuring, from a washing solution containing water and detergent material, a property which is proportional to the detergent concentration of said washing solution, and adding detergent product to the washing solution if the value of the measured property corresponds to a detergent concentration below a preset threshold value, whereby the measured property is the electroconductivity of the washing solution, said property being measured using a measuring cell including one or more electrodes (3, 4) characterised by the steps of: (a) dosing, during filling of the washing machine with clean water, a sufficient amount of detergent product so as to attain present threshold value, followed by mixing of said dosed tetergent product with the water; (b) measuring the conductivity of the thus obtained wash liquor, after a mixing time of less than 2 minutes; and (c) storing said measured conductivity and the detergent concentration value corresponding thereto, as the preset threshold values, in the memory (3) of a controller (1), which is attached to the measuring cell and controls the dosing of detergent product as a function of the conductivity measured.

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METHOD OF DOSING DETERGENT PRODUCT

FIELD OF THE INVENTION

The present invention relates to a method of dosing detergent product into a washing solution present in an industrial washing machine, in particular an institutional mechanical ware washing machine.

BACKGROUND OF THE INVENTION

In prior art washing systems, the detergent concentration of the washing solution is usually observed by measuring the electroconductivity of the washing solution between at least two electric electrodes immersed in the washing solution.

In this respect, electroconductivity can be simply defined as the ability of a solution to pass an electrical current. In a conventional conductivity sensor contact to the solution is made by two or more electrodes, and a small alternating current is passed between them. This current is related to the solution conductivity.

The conductivity measurement is generally carried out by means of the above-described electrodes and a conductivity amplifier which activates a detergent dosing pump whenever the electroconductivity of the washing solution (and, as a consequence, the detergent concentration) drops below a predetermined threshold value, until the theshold level has been regained. Since the conductivity amplifier may operate up to a high accuracy, it can be ensured under all circumstances that the detergent concentration and washing effect are sufficient, i.e. that the detergent concentration remains constantly above a predeterminede level.

However, it has been observed that the detergent concentration in prior art washing systems usually exceeds considerably the threshold level yielding complete cleanness. This over-dosage of detergent product may amount to tens of percents, thus causing considerable extra operating costs.

In GB-A-2,217,050, this problem related to the usually applied overdosage of detergent material, has been recognised. Consequently, this document discloses a method for reducing this overdosage, wherein the detergent product is periodically added in small dosages and allowed to mix with and dissolve in the washing solution for a pre-determined period of time after each dosage, thus ensuring that no undissolved detergent material affecting the measuring result is left in the washing solution at the start of the next dosing period, and that the conductivity then measured very accurately corresponds to the actual detergent concentration of the washing solution.

It is known that systems for controlling the detergent concentration in a washing solution, in which a pair of electrodes immersed in the washing solution are used, possess shortcomings. For example, the electrodes present in the measuring cell are subject to scumming. That is, the electrodes may be coated by a film when they are used to monitor a hard water solution, and, as a result, an acceptable conductivity level may be indicated when in fact the conductivity, and therefore the detergent concentration of the washing solution, is unacceptably high. Furthermore, food soil in the washing solution is likely to cause contamination of the electrodes which may have a detrimental effect on the accuracy of the conductivity measurement. Finally, the electrodes have been found to be sensitive to scale build-up resulting in erroneous measurements and, as

a consequence, increasing product consumption and operating costs.

Since the mentioned conditions leading to erroneous measurements (i.e. scumming, contamination and scale build-up) occur at the interface between washing solution and electrode, so-called inductive measuring systems comprising electrodeless conductivity measuring sensors have been developed. The type of sensor applied in these inductive systems usually comprises two toroidally wound coils, and when these sensors are immersed in the washing solution to be monitored, said solution provides an electrical coupling between the coils.

US-A-4,733,798 discloses an apparatus for controlling the concentration of a washing solution, wherein the conductivity of said solution is measured using an inductive measuring system comprising an electrodeless sensor.

However, the commercially available inductive measuring systems suitable for monitoring the electroconductivity and thus the detergent concentration of the washing soluton, are up till now extremely expensive. Furthermore, contamination of the coils with food soil can prevent the prolonged establishment of a homogeneous distribution of the detergent product in the washing solution, particularly near the coils. Other drawbacks of inductive measuring systems are the following:

(i) in view of the inductive measuring technique, a certain minimum distance between the coils and the internal wall of the container for holding the washing solution to be monitored, is required. So, this measuring technique is not applicable in containers or pipes of reduced size;

(ii) because the signal produced in the coils is weak, the length of the cables between coils and conductivity amplifier needs to be restricted.

It is, therefore, an object of the present invention to provide a method for controlling the detergent concentration of a washing solution, whereby a cheap and simple measuring system is applied and which does not have the above drawbacks. It is also an object of the invention to provide a method for controlling the detergent concentration of a washing solution, whereby the detergent consumption is minimised and a constant cleaning performance is achieved.

It has now surprisingly been found that these and other objects can be accomplished by carrying out the method of the present invention, whereby the conductivity of the washing solution to be monitored is measured with a measuring cell containing electrodes.

DEFINITION OF THE INVENTION

The present invention provides a method of dosing detergent product into a washing solution present in an industrial washing machine, comprising measuring, from a washing solution containing water and detergent material, a property which is proportional to the detergent concentration of said washing solution, and adding detergent product to the washing solution if the value of the measured property corresponds to a detergent concentration below a preset threshold value, whereby the measured property is the electroconductivity of the washing solution, said property being measured using a measuring cell including 1 or more electrodes, characterised by the steps of:

(a) dosing, during filling of the washing machine with clean water, a sufficient amount of detergent product so as to attain said preset threshhold value, followed by mixing of said dosed detergent product with the water;

(b) measuring the conductivity of the thus obtained wash liquor, after a mixing time of less than 2 minutes; and
(c) storing said measured conductivity and the detergent concentration value corresponding thereto, as the preset threshold values, in the memory of a controller, which is attached to the measuring cell and controlls the dosing of detergent product as a function of the conductivity measured.

DETAILED DESCRIPTION OF THE INVENTION

As a result of the method according to the present invention, the problems related to the use of electrodes are largely overcome. This is achieved by measuring the conductivity of the wash solution in the beginning of a washing cycle for obtaining a preset threshold value for the detergent concentration of the solution.
As a consequence of the early measurement of the conductivity, contamination, scale buildup and scumming of the electrodes which has accumulated during the previous washing cycles, cannot negatively influence the detergent concentration control of the washing solution. This accumulation of fouling of the electrodes may stretch out over a period of months depending on the frequency of service intervals of the installation concerned.

As a result of the method of the invention, a constant detergent concentration throughout the operating life of the electrodes and at a minimised detergent consumption could be attained. Further advantages of the method of the invention are guaranteed constant cleaning performance using a relatively cheap system including measurement cells containing one or more electrodes, and improved reliability resulting in a reduced number of service calls. Furthermore, the applied system is usually fully automatised.

In order to reduce hardware and installation costs, a measuring cell containing only one electrode is preferably applied. In that case, the other "counter" electrode is constituted by the internal wall of the container holding the washing solution to be monitored.

It is desirable that the mixing time before the conductivity is measured, is as short as possible.
When the method of the invention is applied for monitoring the detergent concentration in washing solutions in multi-tank ware washing machines, this mixing time is generally less than 2 minutes, preferably less than 1 minute. Alternatively, when the method of the invention is applied for monitoring the detergent concentration in washing solutions in single tank ware washing machines, this mixing time is generally less than 1 minute, preferably less than 30 seconds, a mixing time of from 5 to 15 seconds being pre-ferred.

For obtaining optimal detergent consumption, the steps according to the present invention are preferably repeated every time the washing machine is filled with clean water. For dosing the correct amount of detergent product when filling the washing machine with clean water, it is desirable to calculate this amount by determining the internal water volume of the washing machine to be applied. The method of the invention turned out to be particularly suitable for controlling the detergent concentration of washing solutions present in institutional ware washing machines.

In the method of the invention, an alarm function can be included, indicating that the electrodes applied have been contaminated to such extent and that, consequently, their

sensitivity has deteriorated so much, that suitable operation of these electrodes is not possible anymore. This alarm function is usually adjustable such that it gives a visual or audible signal when the sensitivity of the electrodes has reduced to a level in the range of 50-70 % of the sensitivity value at the start of their operating life. The specific adjustment of the alarm function depends on the accuracy of the concentration control required: when a higher accuracy is required the alarm will be adjusted to a higher percentage of the initial sensitivity. In other words: in that case, less fouling of the electrodes will be tolerated.

The invention will now be further explained by way of the following preferred embodiment and with reference to the accompanying drawing in which figure 1 schematically illustrates a system for carrying out the method of the invention.

This figure shows a block diagram of this system, including a conductivity amplifier/controller (1) which is connected to measuring electrodes (3) and (4), one of which may be the internal wall of a container holding a washing solution to be monitored by said system.. These electrodes are immersed in the washing solution at a suitable location. This location is not critical; however, a measuring point positioned close to the detergent feeding point detects the effect of fed detergent product more rapidly. The conductivity amplifier/controller (1) measures the electroconductivity of the washing solution between the measuring electrodes (3) and (4) and generates at its output an activating signal (AKT) when the measured conductivity drops below a preset threshold value. This preset value is measured during the beginning of the wash cycle, and subsequently stored in the memory (3).

The output of the conductivity amplifier/controller (1) is connected to a control input of a control unit (2) for a detergent dosing pump. This control unit (2) switches on the dosing pump only if the signal AKT is generated.

The invention is illustrated by way of the following non-limiting Examples.

Examples 1, 2, 3, Comparative Examples A, B, C

A detergent product having the following composition was tested in an industrial mechanical dishwashing machine containing a measuring cell including a pair of conductivity electrodes:

Component	Parts by weight
Sodium hydroxide (50%)	35.5
Bayhibit AM (1)	3.0
Norasol LMW 45 N (2)	3.0
Demineralised water	58.8

wherein :

(1) Bayhibit AM : Phosphono-1,2,4-butane-tricarboxylic acid (50%), ex Bayer

(2) Norasol LMW 45 N : Sodium salt of polyacrylic acid, ex Norsohaas.

First, three mechanical dishwashing cycles were carried out with a clean conductivity probe at various dosing levels, to obtain an indicated detergent product level of respectively 1.5 g/l, 2.0 g/l, and 3.5 g/l. Subsequently, at each of these dosing levels two mechanical dishwashing cycles were carried out with a scaled conductivity probe: one cycle whereby a pre-set threshold value according to the method of the present invention was used, and a second comparative cycle whereby said pre-set threshold value was

not used. In other words: during the mechanical dishwashing cycles according to the invention the scaling effect of the probe was compensated, whereas said compensation was not carried out during the comparative cycles. During all dishwashing cycles, the actual detergent level in the wash liquor was measured.

The following actual product concentrations in the mechanical dishwashing liquors (in g/l) were found:

Example		1	A
Indicated detergent product level	Clean probe	Scaled probe Compensated	Uncompensted
1.5 g/l	1.5	1.5	2.2

Example		2	B
Indicated detergent product level	Clean probe	Scaled probe Compensated	Uncompensted
2.0 g/l	2.0	2.0	2.8

Example		3	C
Indicated detergent product level	Clean probe	Scaled probe Compensated	Uncompensted
3.5 g/l	3.5	3.5	4.3

It can be noted that at all dosing levels tested more detergent product was actually applied than indicated, when uncompensated scaled conductivity probes were used. On the other hand, the actual detergent product concentration in the wash liquor was found to be equal to the indicated product level when compensated scaled probes were applied.

CLAIMS

1. A method of dosing detergent product into a washing solution present in an industrial washing machine, comprising measuring, from a washing solution containing water and detergent material, a property which is proportional to the detergent concentration of said washing solution, and adding detergent product to the washing solution if the value of the measured property corresponds to a detergent concentration below a preset threshhold value, whereby the measured property is the electroconductivity of the washing solution, said property being measured using a measuring cell including one or more electrodes, characterised by the steps of:
(a) dosing, during filling of the washing machine with clean water, a sufficient amount of detergent product so as to attain said preset threshhold value, followed by mixing of said dosed detergent product with the water;
(b) measuring the conductivity of the thus obtained wash liquor, after a mixing time of less than 2 minute; and
(c) storing said measured conductivity and the detergent concentration value corresponding thereto, as the preset threshold values, in the memory of a controller, which is attached to the measuring cell and controlls the dosing of detergent product as a function of the conductivity measured.

2. The method according to claim 1, wherein the measuring cell contains 2 electrodes.

3. The method according to claim 1 or 2, wherein the conductivity of the wash liquor is measured after a mixing time of less than 1 minute.

4. The method according to any of the preceding claims, wherein the steps mentioned in claim 1 are repeated whenever the washing machine is filled with clean water.

5. The method according to any of the preceding claims, wherein the amount of detergent product to be dosed for obtaining the preset threshhold concentration value is calculated by determining the internal water volume of the washing machine.

6. The method according to any of the preceding claims, whereby said method is carried out in an industrial ware washing machine.

7. The method according to any of the preceding claims, wherein an alarm element is applied which indicates when the sensitivity of the electrodes has reduced to a level in the range of 50-70% of the sensitivity at the start of their oparting life.

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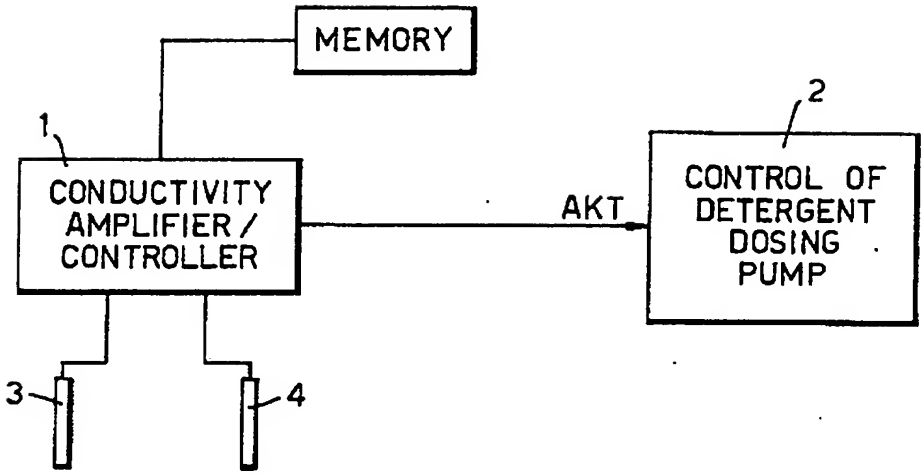
Fig.1.


MEMORY
1
2
CONDUCTIVITY AMPLIFIER / CONTROLLER
AKT
CONTROL OF DETERGENT DOSING PUMP
3
4

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/EP 94/03493

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D06F39/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D06F A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,3 645 669 (G. RAUSCH) 29 February 1972 see column 4, line 14 - line 31 see column 5, line 55 - column 6, line 12 see figures	1,2
A	EP,A,0 506 137 (HITACHI LDT.) 30 September 1992 see column 9, line 29 - column 10, line 23; claims; figures	1,2
A	GB,A,2 217 050 (VESA HAKULINEN) 18 October 1989 cited in the application see claims; figures	1,2

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[X] Further documents are listed in the continuation of box C.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 733 798 (ECOLAB INC.) 29 March 1988 cited in the application see abstract; figures	1
A	FR,A,2 412 638 (ASKO-UPO OY) 20 July 1979 see claims; figure	1,2

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Information on patent family members

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